

FIGURE 4.4 Granite is an intrusive, phaneritic igneous rock. It has a low color index (light color) and is composed chiefly of quartz and feldspar mineral crystals (see Figure 2.1). Ferromagnesian mineral crystals in granites generally include biotite and amphibole (hornblende). This sample contains pink microcline, white plagioclase, gray quartz, and biotite mica. Granites rich in potassium feldspar appear pink like this one, whereas those poor in K-spar appear gray or white.

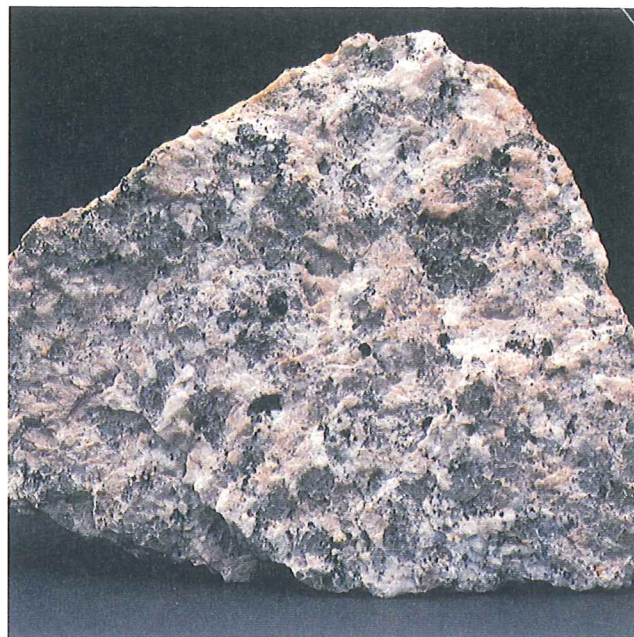
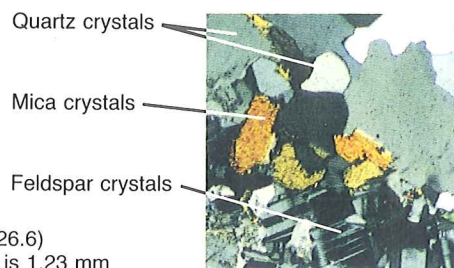


FIGURE 4.5 Rhyolite is an aphanitic igneous rock that is the extrusive equivalent of a granite. It is usually light gray, when rich in light-colored feldspars and quartz. Some rhyolites resemble andesite (see Figure 4.7), so their identification should be finalized where possible by microscopic examination to verify the predominance of quartz and feldspar mineral crystals. (Also see Figure 4.11.)

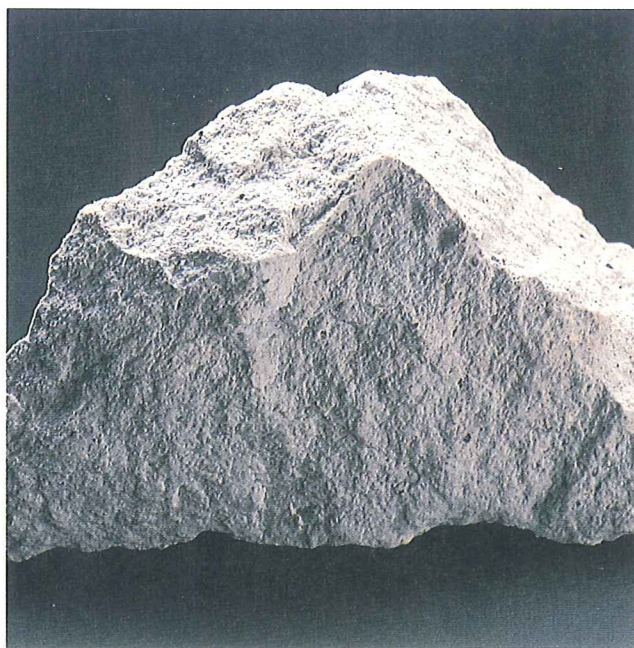
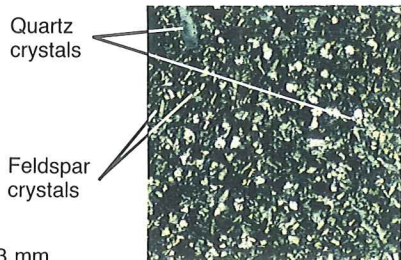


FIGURE 4.6 Diorite is an intrusive, phaneritic igneous rock that has an intermediate color index and is composed chiefly of plagioclase feldspar and ferromagnesian mineral crystals (see Figure 4.1). The ferromagnesian mineral crystals are chiefly amphibole (hornblende). Quartz is only rarely present and only in small amounts (<5%).

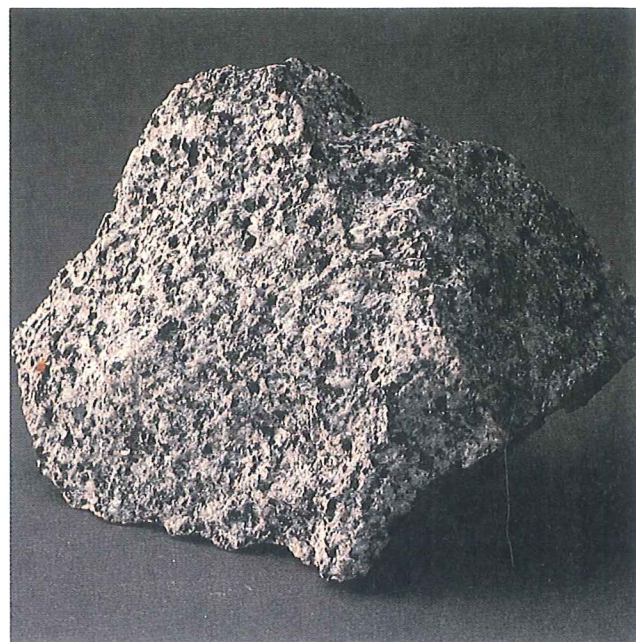
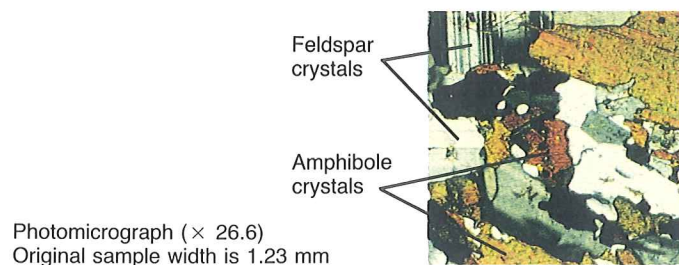


FIGURE 4.7 Andesite is an aphanitic igneous rock that is the extrusive equivalent of diorite. It is usually medium-to-dark gray. Some andesites resemble rhyolite, so their identification is best finalized by microscopic examination to verify the predominance of plagioclase feldspar and ferromagnesian mineral crystals. This sample has a porphyritic-aphanitic texture, because it contains phenocrysts of amphibole and feldspar. (Also see Figure 4.10.)

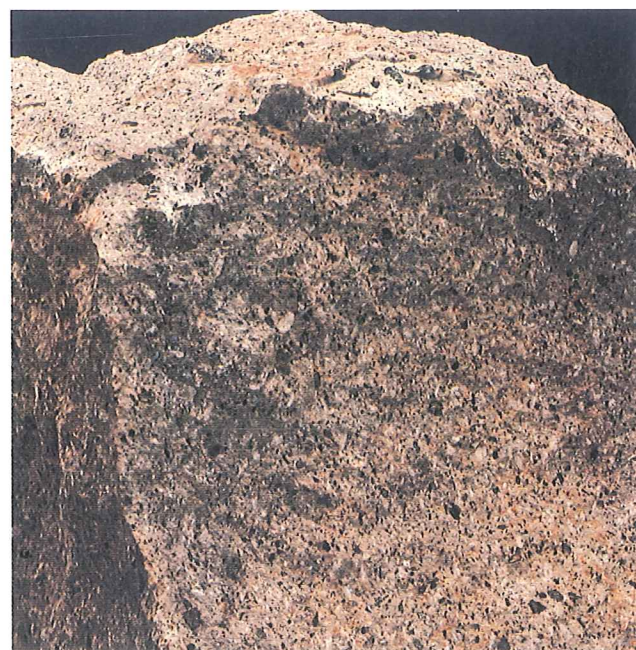
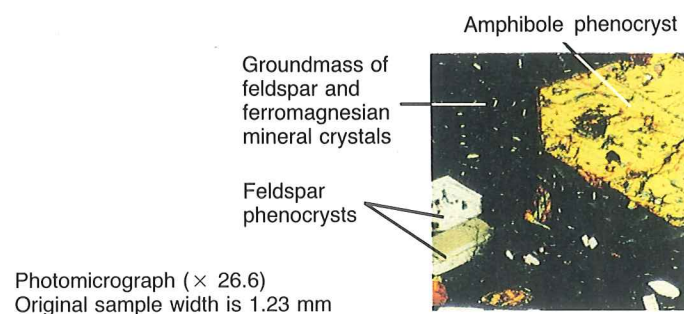
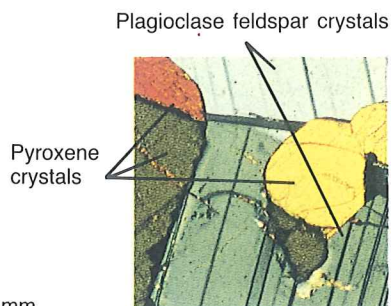


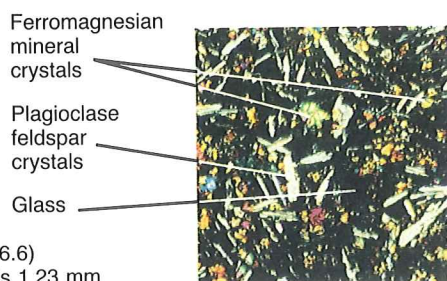
FIGURE 4.8 Gabbro is an intrusive, phaneritic igneous rock having a high color index (dark) and composed chiefly of ferromagnesian and plagioclase feldspar mineral crystals. The ferromagnesian mineral crystals usually are pyroxene (e.g., augite). Quartz is absent. Gabbros composed only of plagioclase feldspar and pyroxene mineral crystals of about 1–2 mm diameter are commonly called *diabase*.



Photomicrograph ($\times 26.6$)
Original sample width is 1.23 mm



FIGURE 4.9 Basalt is an aphanitic igneous rock that is the extrusive equivalent of gabbro, so it is dark gray to black. This sample has a vesicular texture. Microscopic examination of basalts reveals that they are composed chiefly of plagioclase and ferromagnesian mineral crystals. The ferromagnesian mineral crystals generally are pyroxene, but they also may include olivine or magnetite. Glass also may be visible between mineral crystals. Basalt forms the floors of modern oceans (beneath the mud and sand) and is the most abundant aphanitic igneous rock on Earth.



Photomicrograph ($\times 26.6$)
Original sample width is 1.23 mm

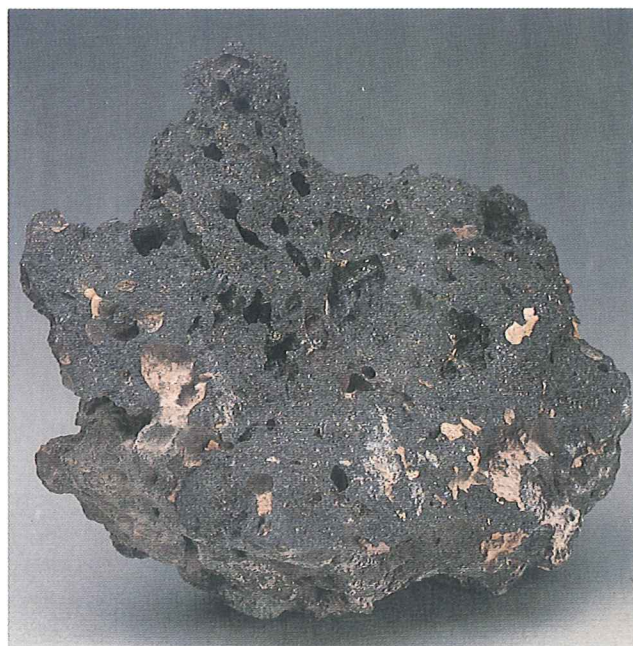




FIGURE 4.10 Porphyritic andesite. This hand sample is mainly aphanitic and medium-gray, so it is an andesite. The specimen also contains phenocrysts (the larger black crystals) of the ferromagnesian mineral hornblende. The phenocrysts are isolated from one another—they “float” within the aphanitic groundmass (matrix). Therefore, this sample of andesite has a phaneritic-aphanitic texture, plus hornblende phenocrysts. Specifically, the rock is a “porphyritic hornblende andesite.”

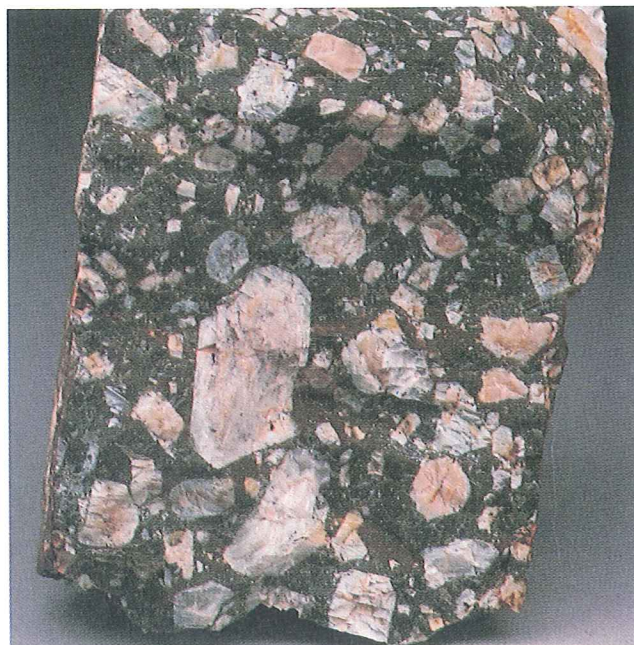


FIGURE 4.11 Porphyritic trachyte. This hand sample is aphanitic. Microscopic examination reveals that the groundmass (matrix) consists chiefly of mineral crystals of potassium feldspar, few mineral crystals of plagioclase and ferromagnesian minerals, and no quartz. Therefore, the groundmass is like a rhyolite, except that it lacks quartz mineral crystals, so the rock is called a *trachyte* (see Figure 4.1). There also are large phenocrysts of potassium feldspar, so the rock’s overall texture is porphyritic-aphanitic.

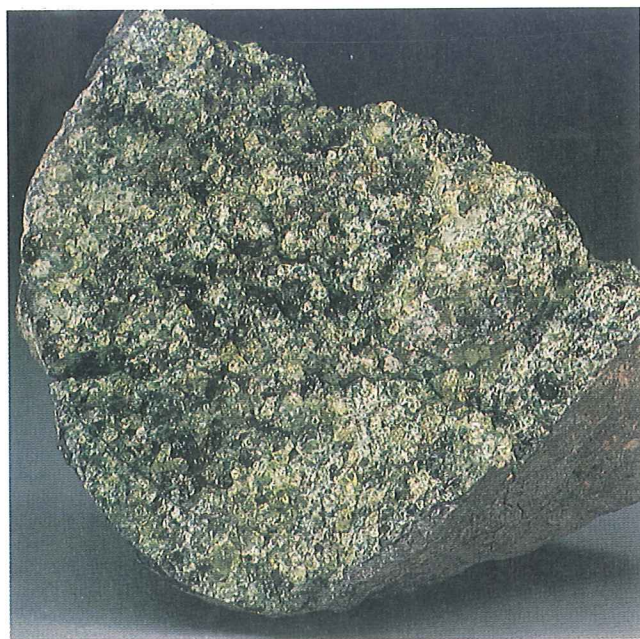


FIGURE 4.12 Peridotite is an intrusive, phaneritic igneous rock having a very high color index (>95%). It is composed essentially of ferromagnesian mineral crystals. The specimen shown is a peridotite composed of olivine mineral crystals; such a peridotite also is called *dunite*. Similarly, a peridotite composed of pyroxene mineral crystals is called *pyroxenite*.

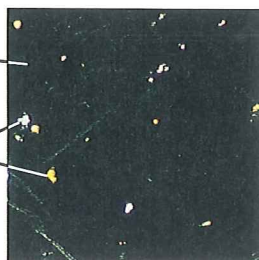


FIGURE 4.13 Scoria is an extrusive igneous rock with a high color index and abundant adjacent vesicles. It can form from the cooling of lava flows that are dense and frothy (bubbly, like whipped egg whites), as in the sample shown. Scoria also can develop from the cooling of gas-charged lava that is explosively ejected from volcanoes, forming scoriaceous volcanic cinders.

FIGURE 4.14 Obsidian is an extrusive igneous rock composed of dark glass (volcanic glass). It forms when lava is cooled very suddenly, or quenched. Such a glassy texture is formally known as a *hyaline texture*. Some obsidian contains phenocrysts of feldspar that are visible in hand samples; such texture is called *porphyritic-hyaline*. Some obsidian also contains microscopic plagioclase feldspar crystals, which impart a glittery reflectiveness; gemstone manufacturers call this “golden-sheen” obsidian.



Glass
Feldspar and
ferromagnesian
mineral crystals



Photomicrograph ($\times 26.6$)
Original sample width is 1.23 mm

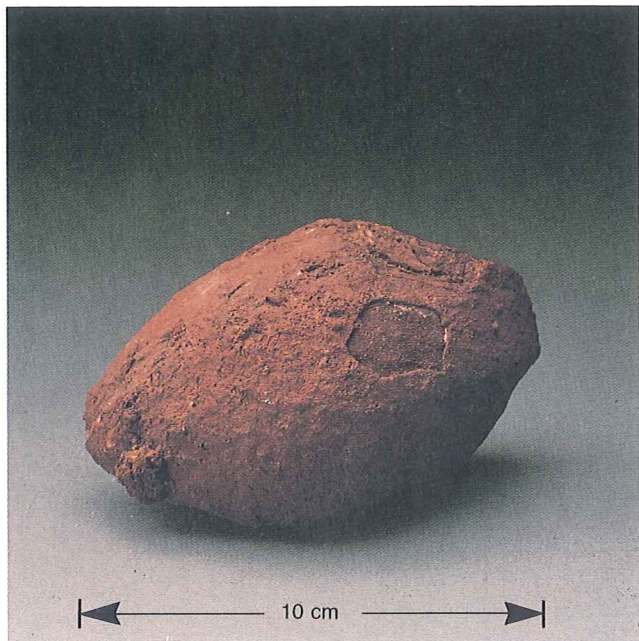
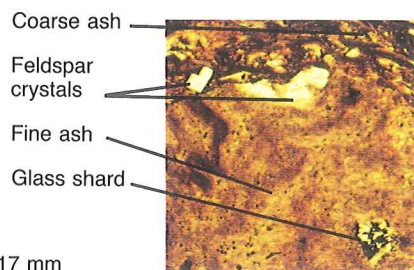
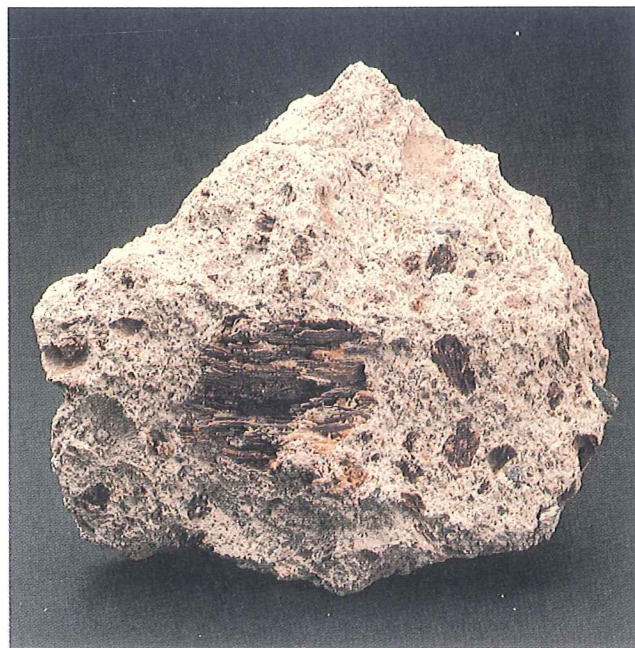


FIGURE 4.15 Volcanic bombs are a type of pyroclast. They are aphanitic, commonly vesicular, cooled masses of lava that were violently ejected from volcanoes and then solidified while in the air. As such, many volcanic bombs have the shape of falling raindrops, as in the sample shown. (Actually they are cooled “lavadrops”!)

FIGURE 4.16 Tuff is an extrusive, pyroclastic igneous rock composed chiefly of volcanic ash fragments of less than 2 mm diameter. Tuff also has a dull, earthy appearance, as in the sample shown. This sample also contains a few large brown pyroclasts.



Photomicrograph ($\times 27.8$)
Original sample width is 1.17 mm

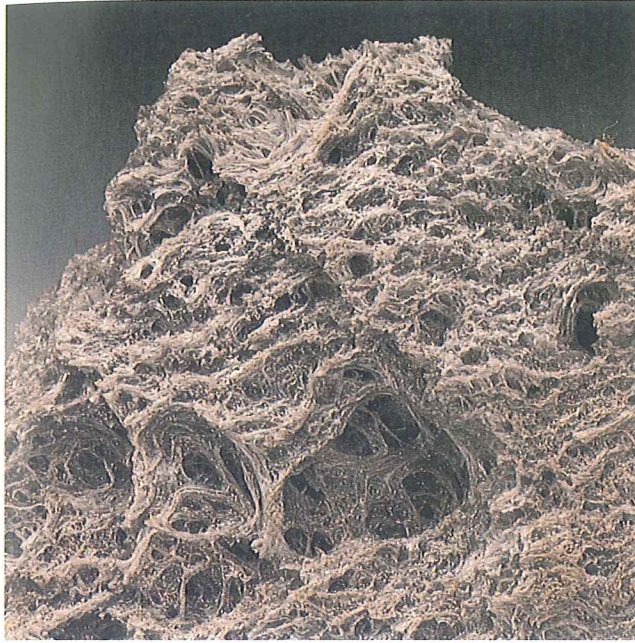


FIGURE 4.17 Pumice is an extrusive igneous rock, generally white to dark gray, having very abundant adjacent vesicles. In these properties, pumice is similar to scoria (Figure 4.13). However, pumice is less dense than scoria. Its density is so low that it floats on water!



FIGURE 4.18 Volcanic breccia is an extrusive igneous rock composed chiefly of pyroclastic fragments of more than 2 mm diameter. These clasts may include volcanic bombs (Figure 4.15) and volcanic cinders. The clasts in this sample are angular pieces of obsidian.



FIGURE 4.19 Granite-pegmatite. Pegmatite is an intrusive, phaneritic igneous rock composed of mineral crystals larger than 1 cm in diameter. The sample shown is a pegmatite having mineral crystals chiefly of gray quartz and white feldspar, so it is a granite-pegmatite. However, there also are diorite-pegmatites and gabbro-pegmatites (see Figure 4.1).